GƎ CONTROL DATA
CORPORATION

CDC® 33801 AND 33502
DISK MEMORY SUBSYSTEMS

INTRODUCTION
HARDWARE
INSTALLATION AND OPERATION

GENERAL INFORMATION MANUAL

REVISION RECORD

REVISION	DESCRIPTION
A	Manual Released
1-7-77	
B	Miscellaneous technical and editorial changes affecting pages iii, 1, 3, 4,
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C	Add description of dual access feature. This edition obsoletes all previous
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E	Add description of 33502. Redefine 33801. This edition obsoletes all
5-3-78	previous editions.

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LIST OF EFFECTIVE PAGES

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New features, as well as changes, deletions, and additions to information in this manual are indicated by bars in the margins or by a dot near the page number if the entire page is affected. A bar by the page number indicates pagination rather than content has changed.

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PREFACE

This manual provides a brief description of the CONTROL DATA® 33801 and 33502 Disk Memory Subsystems. The reader should be thoroughly familiar with the general theory and concept of direct access storage devices.

The information in this manual is organized into three major subject headings:

- Introduction - contains a brief description of subsystem components, standard and optional features, power options, format selection, storage control configurations, compatible operating systems and specifications.

- Hardware - provides a functional description of subsystem components including addressing, error checking and diagnostic capabilities.

- Installation and Operation - describes the installation requirements and operator controls.

Control Data Corporation provides a full complement of service manuals to assist field personnel in maintaining the subsystem. A listing and description of the manuals in the service library is provided below:

Title/Pub. No.	Description of Contents
33801/33502 Subsystem Reference Manual - 83321500	General description including detailed information on data formats, channel interface, channel commands, and operation.
33801/33502 SOLEX User Guide - 22241700	Introduction, requirements, operator procedures, operator communication, AIDE descriptions.
SOLEX Installation Guide - 22241568	Installation, build standalone tape, options.
SOLEX System Reference Manual- 22241400	Introduction, general conventions, SOLEX OS, SOLEX DOS, SOLEX SA.
38302 Troubleshooting Manual - 83322290	CDC storage control microdiagnostic test descriptions, operating procedure, error code dictionary, and corrective action.

Title/Pub. No.	Description of Contents
33801/33502 non-DAF Subsystem Troubleshooting Manual, Vol 1 - 83321600	Controller and device microdiagnostic test descriptions, operating procedure, error code dictionary, and corrective action.
33801/33502 DAF Subsystem Troubleshooting Manual, Vol 1 - 83323100*	Controller and device microdiagnostic Test descriptions, operating procedure, error code dictionary, and corrective action.
3380X Subsystem Troubleshooting Manual, Vol 2- 83321700	Controller and device microdiagnostic test flowcharts.
33801/33502 Subsystem Installation Manual - 83321400	General description, unpacking instructions, installation procedures.
BZ601A-H,BZ602A-H Hardware Reference Manual- 83322580	General description, operation, and theory of operation. See product matrix.
BZ701A-D,BZ702A-D Hardware Reference Manual- 83322610	General description, operation and theory of operation. See product matrix.
BZ601A-H,BZ602A-H Hardware Maintenance Manual, Vol 1 - 83322560	Installation and checkout, preventive and corrective maintenance, exploded view parts data. See product matrix.
BZ701A-D,BZ702A-D Hardware Maintenance Manual, Vol 1 - 83322590	Installation and checkout, preventive and corrective maintenance, exploded view parts data. See product matrix.
BZ601A-H,BZ602A-H Hardware Maintenance Manual, Vol 2 - 83322570	Logic diagrams and wire lists. See product matrix.
BZ701A-D,BZ702A-D Hardware Maintenance Manual, Vol 2 - 83322600	Logic diagrams and wire lists. See product matrix.

*Manual available approximately 9-1-78.

Title/Pub. No.	Description of Contents
33801/33502 User/Analyst Guide - 83322630	Technical information to be used for planning a subsystem installation.
BZ604A-S, BZ605A-S, BZ804A-S, BZ805A-S Hardware Reference Manual - 83323050 (not released)*	General description, operation, and theory of operation. See product matrix.
BZ704A-H, BZ705A-H Hardware Reference Manual - 83323060 (not released)*	General description, operation, and theory of operation. See product matrix.
BZ604A-S, BZ605A-S, BZ704A-H, BA705A-H, BZ804A-S, BZ805A-S Hardware Maintenance Manual, Vol 1 - 83323070 (not released)*	Installation and check-out, preventive and corrective maintenance, exploded view parts data. See product matrix.
BZ604A-S, BA605A-S, BZ804A-S, BZ805A-S, Hardware Maintenance Manual, Vol 2 - 83323080 (not released)*	Logic diagrams and wire lists for controller logic. See product matrix.
BZ604A-S, BZ605A-S, BZ704A-H, BZ705A-H, BZ804A-S, BZ805A-S, Hardware Maintenance Manual, Vol.3 - 83323090 (not released)*	Logic diagrams and wire lists for device logic. See product matrix.
FA109 Hardware Reference Manual - 83321800	General description, operation, and theory of operation (38302)
FA109 Hardware Maintenance Manual, Vol 1-83322470	Preventive and corrective maintenance, wire lists.
FA109 Models A thru U Hardware Maintenance Manual, Vol 2 - 83322480	Logic diagrams.
FA721/FA7A9/FA109 Hardware Maintenance Manual, Vol 3 - 83306000	Exploded view parts data information.
FA109/3330X/33801/ 33502, Functional Microprogram Manual- 83322330	Core map, cross reference listing, and microdraws.
FA721/FA7A9/FA109 Standalone Microprogram Diagnostics Manual - 83312100	Core map, cross reference listings, and microdraws.
IBM 3830-2/ ISC/3330X/33801/ 33502 Subsystem Functional Microprogram Manual - 83322700*	Core map, cross reference listings, and microdraws.

Manuals may be ordered through:

Control Data Corporation
8001 E. Bloomington Freeway
Bloomington, MN 55420
U.S.A.

Attn: Literature Distribution Services

*Manual available approximately 1-1-79.

PRODUCT MATRIX

	Product Type	EC Number
Non-DAF	33801 B2	BZ701X
	33502 B2	BZ702X
	33801 A2	BZ601X
	33502 A2	BZ602X
DAF	33801 B2	BZ704X
	33502 B2	BZ705X
	33801 A2	BZ604X
	33502 A2	BZ605X
	33801 C2	BZ804X
	33502 C2	BA805X

X Indicates unique variable (SS, 60/50 Hz etc.)

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33801-C2
OR
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33502-B2

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OR
33502-A2

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INTRODUCTION

GENERAL DESCRIPTION

The CDC 33801 and 33502 Disk Memory Sub-systems are high speed, random access storage facilities for data base, date communications, or general purpose use. Both subsystems provide direct access storage for medium to large scale IBM System/370 computer systems, IBM System/360 model 85 and 195 computer systems, and equivalent systems by other manufacturers.

The 33801 subsystem consists of one CDC 38302 Storage Control unit and one to four strings of CDC 33801 dual-device Disk Storage units.

The 33502 subsystem also consists of one CDC 38302 Storage Control Unit and one to four strings of CDC 33502 dual-device Disk Storage units. The 33801 or 33502 units may be freely intermixed between subsystems, and within the same device string.

At the customers option, the CDC 38302 Storage Control may be replaced by an IBM 3830 Model 2 storage control or by an Integrated Storage Control. Three models of the 33801 and 33502 are available: two containing an integrated controller in addition to dual-devices, and one containing only dual-devices. All models are available with or without fixed head storage. Models configured with fixed head capability are identified by the letter "F" appended to the model type designator.

Each device in the 33801 unit has a maximum storage capacity of 400 megabytes. A subsystem consisting entirely of 33801 units provides a maximum storage capacity of 12 800 megabytes when 16 units (32 devices) are attached.

Each device in the 33502 unit has a maximum storage capacity of 635 megabytes. A subsystem consisting entirely of 33502 units provides a maximum storage capacity of 20 320 megabytes when 16 units (32 devices) are attached.

The first unit in each string must be a Model A2 or A2F dual-device with integrated controller. Up to three additional Model B2 or B2F units may be attached to the A2/A2F unit. Where increased data availability is required, the dual access feature or alternate controller feature, or a combination of both features, may be used for device sharing. Dual access provides dynamic i.e. online device sharing. The alternate controller feature is manually selectable in the event of primary controller failure.

When dual access is used, two A2/A2F units are required. Up to six additional B2/B2F units can be attached. Use of this feature can significantly improve subsystem performance and throughput, in addition to providing a redundant data path.

When alternate controller is selected, the last B2/B2F unit is replaced by a Model C2 or C2F dual-device. The Model C2/C2F functions as a Model A2/A2F or B2/B2F depending upon the setting of a manual switch on the unit.

Both subsystems are plug compatible with the IBM 3350 Direct Access Storage Facility at the channel and controller interface.

STANDARD FEATURES

The following standard features are built into every 33801 or 33502 subsystem:

- **Defect Skipping** — Permits the device to record data ahead of, and following, a surface defect. Total data capacity is not affected.

- **Data Protection** — Write commands can be inhibited by using the READ ONLY switch/indicator on the unit operator panel.

- **Diagnostic Software** — Control Data SOLEX diagnostics permit the operator to test the subsystem online under operating system control, or standalone using SOLEX supervisor and monitor. A total of 25 SOLEX AIDES are provided.

- **Diagnostic Microprogram** — An Inline microprogram package provided with every subsystem permits the customer engineer to perform maintenance on one device without disrupting normal system operation on the remaining devices.

  When the subsystem includes the CDC 38302 Storage Control, a second microprogram package is provided which permits the customer engineer to check the operation of the storage control when the unit is logically disconnected (i.e., Standalone) from the channel.

- **Selective Format – 33801**

  Each 33801 device is formatted at the factory into one of three IBM compatibility modes: 3330-1, 3330-11, or 3350 as specified by customer. Utility programs are also available to reformat previously initialized devices.

  In the 3330-1 compatibility mode, a single 33801 device contains two 3330-1 logical volumes. Each logical volume is equivalent to an actual IBM 3330-1 or CDC 33301 volume in capacity and format.

  In the 3330-11 compatibility mode, a single 33801 device contains two 3330-11 logical volumes. Each logical volume is equivalent to an actual IBM 3330-11 or CDC 33302 volume in capacity and format.

  In the 3350 compatibility mode, a 33801 device contains one IBM 3350 logical volume.

- **Selective Format – 33502**

  Each 33502 device is formatted at the factory into IBM 3350 compatibility mode.

  A single 33502 device contains two 3350 logical volumes. Each logical volume is equivalent to an actual IBM 3350 in capacity and format.

- **Error Detection**

  Data error bursts up to ten bits in length are automatically detected. Error bursts up to four bits in length in data fields are automatically detected and corrected.

- **Write Format Release**

  Permits the storage control to disconnect from the device at the end of the last record field during a format write operation. The device continues to pad zeros to the end of the track.

- **Rotational Position Sensing**

  Permits an I/O disconnect during the period of rotational delay following initialization of a search operation. This frees the channel for other operations.

- **Full Track Read**

  Permits the user to read the remaining records on the track using a single Read Multiple Count, Key and Data channel command (5E)

- **Usage/Error Recording**

  The storage control unit maintains usage and error counters for each device. The usage counter keeps track of the number of seeks executed. Other counters compile the number of seek errors, correctable data errors, and uncorrectable data errors. The total number of command and data overruns retried by the storage control are also accumulated. The contents of these counters are periodically transferred to the channel for system logging.

- **Error Logging**

  Errors are recorded in the storage control and transferred to the central processing unit (CPU) for logging and analysis as an added serviceability function.

- **Channel Disable**

  Permits the operator or customer engineer to logically disconnect the storage control from the channel for maintenance purposes.

OPTIONAL FEATURES

The basic 3380X subsystem may be equipped at the factory or in the field with the following optional features:

- **Two Channel Switch STO 68426-1**

  Permits the CDC 38302 Storage Control to be shared by two block multiplexer channels. The two channels may be attached to the same system or to two different systems.

- Four Channel
  Switch
  STO 68426-3

  Permits the CDC 38302
  Storage Control to be
  shared by up to four
  block multiplexer
  channels. A maximum

- Four Channel
  Switch STO
  68426-3 (Contd)

  of two channels may
  be on the same
  system.

- Register
  Expansion
  STO 69055-1

  Provides additional
  registers for micro-
  program use. This
  feature is required
  when the CDC 38302
  Storage Control is
  attached to 33801
  or 33502 units.

- Memory
  Expansion
  STO 68428-2

  Expands CDC 38302
  Storage Control
  microprocessor
  memory from 4K to 6K.
  This feature is re-
  quired when attaching
  to 3380X units.

- Memory
  Expansion
  STO 69054-1

  Expands CDC 38302
  Storage Control
  microprocessor
  memory from 6K to 8K.
  This feature is re-
  quired when attaching
  to 33801 or 33502 units.

- String Switch
  (SS)
  STO 69070-3

  Permits the integrated
  controller in the 33801
  or 33502 Model A2/A2F
  to be dynamically
  shared by two storage
  control units. Either
  storage control can
  operate or reserve
  any of the online de-
  vices, but both
  storage control units
  cannot select the con-
  troller simultaneously.

- String Switch
  (SS)
  STO 69070-5

  Same as STO 69070-3
  except applies to
  model C2/C2F.

- Hardware
  Analysis Program
  (HAP), Product
  3380X-902

  Permits the operator
  to perform a quick
  analysis of the device
  and storage media.

- Primary
  Controller
  Adapter
  STO 69072-1

  This feature, installed
  in the A2/A2F unit,
  permits the user to
  manually select either
  the A2/A2F or C2/C2F
  unit as the online
  controller. The
  selection is made via
  the PRIMARY/ALTERNATE
  switch located on the
  C2/C2F unit. Switch-
  ing must be preceded
  by a power off on the

  A2/A2F unit. This
  feature allows the
  offline controller to
  be serviced with mini-
  mum effect on subsys-
  tem availability.

- 33801 to 33502
  Conversion
  STO 69083-1

  This feature is used
  to convert a 33801 unit
  to a 33502 unit.

- 33502 to 33801
  Conversion
  STO 69083-2

  This feature is used
  to convert a 33502 unit
  to a 33801 unit.

- Dual Access (DAF)
  STO 69082-1

  Permits devices to be
  dynamically shared by
  two integrated control-
  lers located in sepa-
  rate A2/A2F or C2/C2F
  units. It also per-
  mits the integrated
  controller in the
  Model A2/A2F or C2/C2F
  to control up to
  sixteen devices.

- Fixed Head
  Feature (FHF)
  STO 69071-2

  Permits the device to
  access fixed head
  storage with no seek
  time delay. Total
  data storage is not
  affected because an
  equivalent amount of
  storage under movable
  heads is inaccessible.

POWER OPTIONS

The CDC 38302 Storage Control requires three-
phase, 15 ampere power from either a wye or
delta source. The 33801 or 33502 Model A2 or
A2F drive unit requires three-phase, 60 am-
pere power from a wye or delta power source.
Compatible source voltages are listed below:

50 Hz		60 Hz	
200/208 V		200 V	
220 V	delta	208 V	wye
230/235/240 V		230 V	
380 V			
398/400/408/415 V	wye		

SELECTIVE FORMAT FEATURE

The 33801 and 33502 uses a fixed (non-
removable) head and disk assembly (HDA) as
a storage medium. Each HDA (two per unit)
provides a total of 200, 317.5, 400, or 635
megabytes of direct access storage depend-
ing on mode of operation. The fixed head
feature (FHF) permits the user to access a
portion of the total HDA capacity in lieu
of the same capacity under movable heads.
Table 1 describes the operational modes.

TABLE 1. OPERATIONAL MODES

	Compatibility Mode			
	33801			33502
	2 x 3330-1	2 x 3330-11	1 x 3350	2 x 3350
Logical Volume Capacity (Megabytes)	100	200	317.5	317.5
HDA Capacity (Megabytes)	200	400	317.5	635
Logical Data Cylinders Per Volume	404	808	555	555
Logical Data Cylinders Per HDA	2 x 404	2 x 808	1 x 555	2 x 555
Fixed Head Logical Cylinders	1 thru 5 (1)	1 thru 5 (1)	1 thru 3	1 thru 3 (1)
Fixed Head Data Capacity Megabytes/HDA	1.24	1.24	1.72	1.72
Fixed Head Data Capacity Megabytes/Unit	2.48	2.48	3.44	3.44

(1) Fixed head storage associated only with primary volume.

STORAGE CONTROL CONFIGURATIONS

The Model A2 or A2F interfaces with the computer system via any of the following storage control units:

- CDC 38302 Storage Control

- IBM 3830-2 Storage Control

- IBM System/370 Model 145 and 148 Integrated Storage Control (ISC).

- IBM System/370 Model 145 Storage Control Frame 3345 Models 3, 4, and 5.

- IBM System/370 Models 158 and 168 Integrated Storage Control (ISC).

When attached to the CDC 38302 or IBM 3830-2, the subsystem provides direct access storage for IBM System/360 Models 85 and 195 and System/370 Models 135, 138, 145, 148, 155-II, 158, 165-II, 168, and 195 computer systems. Attachment to the System/360 Models 85 and 195 and System/370 Models 165-II, 168, and 195 is made via the IBM 2880 Block Multiplexer Channel. Attachment to the System/370 Models 135, 138, 145, 148, 155-II, and 158 is made via the system block multiplexer channel.

Each 38302 or 3830-2 Storage Control is capable of interfacing up to four CDC 33801, 33502, or 33301/2 (equivalent to IBM 3330 Models 1 and 11) type strings in any combination. CDC 33801 or 33502 units may not be intermixed with 330X type units in the same string.

When attached to an ISC, the subsystem provides direct access storage via a block multiplexer channel for System/370 Models 145, 148, 158, and 168 computer systems. The System/370 Model 145 and 148 ISC provides a single storage and control path. The System/370 Models 158 and 168 ISC provides a dual storage and control path. Each storage and control path on the ISC is capable of interfacing up to four CDC 33801, 33502, or 33301/2 (equivalent to IBM 3330 Models 1 and 11) type strings in any combination. CDC 33801, 33502 units may not be intermixed with 3330X type units in the same string.

The CDC provided functional microcode for each of the available storage control units is as follows:

SC	Product No.
CDC 38302	38302-901
IBM 3830-2/ISC	33801-901

Table 2 contains a listing of the features required by IBM storage control units when interfacing 33801 or 33502 units.

OPERATING SYSTEMS

The 33801 or 33502 subsystem may be used in a wide variety of IBM operating system environments. Table 3 summarizes the compatibility of these operating systems to various models of the System/360 and System/370 computer.

Table 4 lists the minimum operating system revision level required to accommodate 33301/2, 33801, or 33502 devices.

SPECIFICATIONS

Subsystem specifications are contained in table 5. All values listed are nominal unless otherwise specified.

TABLE 2.   IBM STORAGE CONTROL FEATURES

Storage Control	3380X DASD Feature	Control Store Extension Feature	Expanded Control Store Feature	Word Buffer Feature	Register Expansion Feature	Max. No. of Controllers	Max. No. of Devices
ISC on 3345 Storage and Control Frame Models 3, 4, and 5	①	--	#2152	#8810	#6111	4	32
ISC Feature #4660 on S/370 Models 145 and 148	①	--	#2152	#8810	#6111	4	32
ISC Feature #4650 on S/370 Models 158 and 168	①	#2150 ②	#2151 ②	--	#6111	8	64
3830-2 Storage Control	①	#2150	#2151	--	#6111	4	32

① Functional microprogram provided by CDC.

② ISC/SA Control Store Additional (#2152) required if subsystem includes 3850 Mass Store.

TABLE 3.   OPERATING SYSTEM COMPATIBILITY

		Operating System						
	Model	DOS	DOS/VS	OS/MFT	OS/MVT	OS/VS1	OS/VS2	VM/370
S/360	85	No	No	Yes	Yes	No	No	No
	195	No	No	No	Yes	No	No	No
S/370	135	Yes	Yes	Yes	No	No	No	Yes
	138	Yes	Yes	Yes	No	No	No	Yes
	145	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	148	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	155-II	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	158	Yes	Yes ①	Yes	Yes	Yes	Yes	Yes
	165-II	No	No	Yes	Yes	Yes	Yes	Yes
	168	No	No	Yes	Yes	Yes	Yes	Yes
	195	No	No	No	Yes	No	No	No

① Simplex (single processor) configuration only.

TABLE 4.   MINIMUM OPERATING SYSTEM REVISION LEVEL

Device Type	Operating Mode	Operating System							
		DOS	DOS/VS	OS/MFT	OS/MVT	OS/VS1	OS/VS2 SVS	OS/VS2 MVS	VM/370
33301 (3330-1)	3330-1	Release 27	All Releases	Release 21.7	Release 21.7	All Releases	All Releases	All Releases	All Releases
33302 (3330-11)	3330-11	Not Usable	Release 30 ①	Release 21.6 ②	Release 21.6	All Releases	All Releases	All Releases	All Releases
33801	3330-1	All Releases	All Releases	Release 21.7	Release 21.7	All Releases	All Releases	All Releases	All Releases
	3330-11	Not Usable	Release 30 ①	Release 21.6 ②	Release 21.6 ②	All Releases	All Releases	All Releases	All Releases
	3350	Not Usable	Release 34.0	Not Usable	Release 21.8 ③	All Releases	④	⑤	All Releases

① With PRPQ EF 4346
② With FDP 5798-BCE
③ With FDP 5799-ARG
④ Release 1.7 with ICR 5742-017
⑤ Release 3.0 with ICR 5742-VS2

TABLE 5. SUBSYSTEM SPECIFICATIONS

Function	Condition	Specification
Physical Specifications		
38302 Size	Height Width Depth	60.0 in (1524 mm) 28.0 in (711.2 mm) 44.5 in (1130 mm)
38302 Service Clearances	Front Rear Right Left	36.0 in (914 mm) 24.7 in (628.6 mm) 36.0 in (914 mm) 36.0 in (914 mm)
33801/33502 Size	Height Width Depth	44.4 in (1128 mm) 42.0 in (1067 mm) ① 33.3 in (843 mm)
33801/33502 Service Clearances	Front Rear Right Left	36.0 in (914 mm) 36.0 in (914 mm) 24.0 in (610 mm)-end B2/B2F,C2/C2F 36.0 in (914 mm)-A2/A2F only
Weight	38302 33801/33502-A2/A2F,C2/C2F 33801/33502-B2/B2F	700 lb (317.5 kg) 1100 lb (499 kg) 1050 lb (476 kg)
Operating Environment	Temperature Temp. Gradient Humidity Altitude	59°F (15°C) to 90°F (32°C) 9°F (5°C) per hour 10% to 80% -980 ft (+787 mm Hg) MSL to +6560 ft (+597 mm Hg) MSL
Electrical Specifications		
38302 Source Power	Current/Voltage	15A 200,208,230 V, three-phase, wye, 60 Hz 200,220,230-240 V, three-phase, delta or wye, 50 Hz 380,398-415 V, three-phase, wye, 50 Hz
33801/33502-A2/A2F Source Power	Current/Voltage	60 A 200,208,230 V, three-phase, wye, 60 Hz 200,220,230-240 V, three-phase, delta or wye, 50 Hz 380,398-415 V, three-phase, wye, 50 Hz
38302 Power Consumption	Apparent Power Power Factor Head Dissipation	1.8 kVA 0.90 5500 Btu/h (1600 W)

① Standalone dimension for A2/A2F is 44.4 in (1128 mm) with 1.2 in (30 mm) end cover on each side. End B2/B2F or C2/C2F unit dimension is 43.2 in (1097 mm) with 1.2 in (30 mm) cover added.

Table continued on next page

TABLE 5. SUBSYSTEM SPECIFICATIONS (Contd)

Function	Condition	Specification
Electrical Specifications (Contd)		
33801/33502-A2/A2F, C2/C2F Power Consumption (Accessing)	Apparent Power Power Factor Heat Dissipation Line Current per phase	3.15 kVA 0.85 9100 Btu/h (2680 W) 8.75 Ampere
33801/33502-B2/B2F Power Consumption (Accessing)	Apparent Power Power Factor Heat Dissipation Line Current per phase	2.8 kVA 0.85 8100 Btu/h (2380 W) 7.75 Ampere
Unit Circuit Breaker	38302 33801/33502-A2/A2F, 33801/33502-B2/B2F,C2/C2F	15 A 40 A 15 A
38302 Power Cord	Plug-CDC provided Connector or ⎱ cust. Receptacle ⎰ provided	Russell & Stoll FS 3730 Russell & Stoll FS 3914 Russell & Stoll FS 3744
33801/33502-A2/A2F Power Cord	Plug-CDC Provided Connector or ⎱ cust. Receptacle ⎰ provided	Russell & Stoll FS 7328 Russell & Stoll FS 7428 Russell & Stoll FS 7324
Disk Drive Accessing (Per Volume)		
Seek Times	One Track Average Full Volume Seek	10 ms Maximum 18 ms Maximum 30 ms Maximum
Data Recording Specifications		
Logical Cylinders Per HDA	3330-1 Mode 3330-11 Mode 3350 (33801) Mode 3350 (33502) Mode	808 1616 555 1110
Logical Cylinders Per Volume	3330-1 Mode 3330-11 Mode 3350 Mode	404 (plus 7 alternates) ① 808 (plus 7 alternates) ② 555 (plus 5 alternates) ③
Tracks Per Cylinder	3330-1 Mode 3330-11 Mode 3350 Mode	19 19 30
Tracks Per Volume	3330-1 Mode 3330-11 Mode 3350 Mode	7676 (plus 133 alternates) 15 352 (plus 133 alternates) 16 650 (plus 150 alternates)
Track Capacity (Bytes)	3330-1 Mode 3330-11 Mode 3350 Mode	13 030 13 030 19 069

① Data Tracks = 0-403, Alternate Tracks = 404-410

② Data Tracks = 0-807, Alternate Tracks = 808-814

③ Data Tracks = 0-554, Alternate Tracks = 555-559

TABLE 5. SUBSYSTEM SPECIFICATIONS (Contd)

Function	Condition	Specification
Data Recording Specifications (Contd)		
Cylinder Capacity (Bytes)	3330-1 Mode 3330-11 Mode 3350 Mode	247 570 247 570 572 070
Volume Capacity	3330-1 Mode 3330-11 Mode 3350 Mode	100 megabytes 200 megabytes 317.5 megabytes
HDA Capacity	3330-1 Mode 3330-11 Mode 3350 (33801) Mode 3350 (33502) Mode	200 megabytes 400 megabytes 317.5 megabytes 635 megabytes
Fixed Head Storage Specifications		
Logical Cylinders Per HDA	3330-1 Mode 3330-11 Mode 3350 Mode	1-5 (primary volume only) 1-5 (primary volume only) 1-3 (primary volume only)
Tracks	3330-1 Mode 3330-11 Mode 3350 Mode	0-18 0-18 0-29
Tracks Per Logical Cylinder	3330-1 Mode 3330-11 Mode 3350 Mode	19 19 30
Capacity Per HDA (Bytes)	3330-1 Mode 3330-11 Mode 3350 Mode	1 237 850 1 237 850 1 716 210
Capacity Per Unit (Bytes)	3330-1 Mode 3330-11 Mode 3350 Mode	2 475 700 2 475 700 3 432 420
Data Transfer Specifications		
Rotational Delay	Average Latency Maximum Latency	8.4 ms ⎫ 3600 r/min 16.7 ms ⎭
Data Rate	Bytes Per Second	1 198 000
I/O Specifications		
Maximum Cable Length (port-to port)	Channel Controller	150 ft (45.7 m) 200 ft (60.97 m)

FUNCTIONAL DESCRIPTION

The 33801 and 33502 Disk Memory Subsystem consists of one storage control (CDC or IBM) and one to four device strings. No more than four strings can be attached to the same storage control. Strings of IBM 3350 devices can be intermixed on the same storage control at the customers option. The first unit in each string must be a Model A2 or A2F containing an integrated control. Up to three Model B2 or B2F units may be attached to the Model A2 or A2F. When the alternate controller feature is used, the last Model B2 or B2F unit in a string of units is replaced by a Model C2 or C2F unit containing an alternate integrated control.

When interfaced to an IBM block multiplexer channel, the subsystem operates under direct program control of the central processor unit (CPU). All compatible storage control units respond to the same channel command set. These commands and their functions are summarized in table 6.

TABLE 6. CHANNEL COMMAND SUMMARY

	Command	Function	Count Field
CONTROL	Restore	No action	Non Zero
	No Operation	No action	Non Zero
	Recalibrate	Seek heads to cylinder zero, head zero	Non Zero
	Seek Seek Cylinder	Seek is specified cylinder and head	Six (address) first two not significant
	Seek Head	Select specified head	Six (address) first five not significant
	Set File Mask	Defines write and seek commands to be permitted.	One (file mask)
	Set Sector	Specifies angular track position for record to reach head	One (0 to 127 or 255) 255 = no operation
	Space Count	Allows bypassing of defective count area for recovery of data in following key/data fields	Three (one key length, two data length for next command)
	Diagnostic Load	Transfers 512 bytes of data from flexible disk to Storage Control Memory	One (diagnostic test ID)
	Diagnostic Write	Transfers 512 bytes of data from CPU storage to Storage Control Memory	512 (test)
	Transfer In Channel	Provides chaining capabilities for CCWs not located in adjacent CPU main storage locations.	Ignored
	Table continued on next page		

TABLE 6.   CHANNEL COMMAND SUMMARY (Contd)

	Command	Function	Count Field
SENSE	Sense I/O	Transfers sense information from Storage Control memory to channel	24 (sense)
	Read and Reset Buffered Log	Transfers usage or error information from Storage Control memory to channel	24
	Device Release	Terminates reservation of device*	24 (sense)
	Device Reserve	Reserves device to channel issuing command*	24 (sense)
	Read Diagnostic Status 1	For maintenance only: a) If part of diagnostic write operation, transfers error code message to main storage	16 (error code message)
		b) If part of diagnostic load operation, transfers diagnostic test from Storage Control to CPU Storage	512 (diagnostic test data)
	Sense I/O Type	Transfers device type information to channel	7
	Test I/O	Determines status of device on channel (automatically generated by channel when status is required)	one (status)
	Unconditional Reserve	Allows the controller or device alternate path interface to force an I/O release of the active path in the event of hardware malfunction. Reserves the device to the channel issuing the command.	24
SEARCH	All searches compare data read from HDA with data supplied by channel (argument). Ending status byte indicates if search conditions are satisfied.		
	HA Equal	Search Home Address for equality	Four (cylinder and head)
	ID Equal	Search ID of count field for equality	Five (cylinder, head, record number)
	ID High	Search for ID from device higher than channel argument	Five (cylinder, head, record number)
	ID Equal or High	Search for ID from device equal to, or higher than, channel argument	Five (cylinder, head, record number)
	Key Equal	Search key field for equality	Length of Argument
	* This command utilized only for multi-channel/multi-system operation.		
	Table continued on next page		

TABLE 6. CHANNEL COMMAND SUMMARY (Contd)

	Command	Function	Count Field
SEARCH (Contd)	Key High	Search for key field from device higher than channel's	Length of Argument
	Key Equal or High	Search for key field from device equal to, or higher than, channel's	Length of Argument
READ	Read HA	Transfer home address record to channel	Five (flag, cylinder, head)
	Read Count	Transfer count field of next record (excluding R0) to channel	Eight (cylinder, head, record number, key length, 2 data length)
	Read R0	Transfer count/key/data fields of Record Zero to channel	Number of bytes to be read
	Read Data	Transfer data field to channel	
	Read Key and Data	Transfer key and data fields to channel	
	Read Count, Key, and Data	Transfer next record (except R0) to channel	
	Read IPL	Device seeks to cylinder zero, head zero. After Index is detected, data field of first record following R0 is transferred to channel.	
	Read Sector	Transfers sector number of last record processed	One
	Read Multiple Count, Key and Data	Transfers remaining records on track to channel (except R0)	
WRITE	Write HA (Format	Write Home Address on selected head	3330 modes: Five (flag, cylinder, head) 3350 mode: Eleven (skip displacement, flag, cylinder, head) If executed in 3350 mode, instruction must chain from a successful search HA with CCW count = 4 or more if flag bit six is off.
	Write R0 (Format)	Write entire Record Zero	Number of bytes to be written
	Write Count, Key, and Data (Format)	Write entire record (except HA and R0)	
	Write Special Count, Key, and Data (Format)	Writes segment of overflow record (except last segment)	

TABLE 6. CHANNEL COMMAND SUMMARY (Contd)

	Command	Function	Count Field
WRITE (Contd)	Write Data (Update)	Write data field of record	
	Write Key and Data (Update)	Write key and data fields of record	
	Erase (Format)	Write zeros in record and erase remainder of track	

STORAGE CONTROL DESCRIPTION

The 38302 Storage Control is a micro-programmed control unit equipped with a 4, 6, or 8K by 40-bit monolithic, random access, memory of 200 nanosecond cycle time. Note: the unit must be configured with 8K of micro-processor memory when used with 33801 or 33502 Disk Storage Units.

The microprogram is stored on a flexible disk located in the storage control cabinet. This disk, which is easily removable, stores the entire operational microprogram. Data is loaded into monolithic memory during sub-system power up.

The storage control performs the following basic functions:

● Executes commands issued by the channel

● Controls read/write data transfers between the channel and the A2/A2F or C2/C2F integrated controller

● Provides the channel with subsystem status

● Executes microdiagnostic tests

● Sequences power to the attached drive units

Storage control microdiagnostic tests are contained on a separate flexible disk provided with the unit.

Basic Microprocessor Operation

All subsystem operations are controlled by the microprogram loaded from the flexible disk into microprocessor memory.

After decoding, the word is executed and used to perform the following functions:

● Define the arithmetic or logical operations to be performed by the arithmetic/logical unit (ALU) and specify the source and destination registers to be used in the operation.

● Initiate, if necessary, a microprogram memory read or write operation

● Control I/O operations

● Select the next microcode instruction to be executed. The next instruction address can be modified on the basis of tests performed on the previous instruction.

Other circuits control communication between the channel and the integrated controller.

DISK STORAGE UNIT

The disk storage unit provides from 400 to 1270 megabytes of direct access storage. A unit cabinet contains two deck assemblies each equipped with a fixed (nonremovable) head and disk assembly (HDA). Both decks share a common air distribution system and ac/dc power supplies. All remaining device circuitry is duplicated for each deck assembly.

The device logic performs the following functions:

● Responds to control signals (tags) from the controller

● Positions the access mechanism to a physical cylinder location

● Selects the read/write head

● Locates a specified sector on a selected track

● Provides status information to the controller

The controller located in the A2/A2F and C2/C2F cabinet contains the circuitry required to interface the storage control to each device in the string. All controller interface signals, except power sequencing control, are wired directly into a separate controller logic chassis located underneath the device logic chassis. Controller power sequence lines are connected to a separate relay logic board assembly.

The controller logic performs the following functions:

- Responds to control signals (tags) from the storage control.

- Controls read/write data transfers between the storage control and device.

- Controls the placement and interpretation of device track format fields.

- Provides status information to the storage control.

- Provides error detection and correction information to the storage control.

- Serializes and deserializes data.

- Controls diagnostic evaluation of the device.

Controller and device microdiagnostic tests are contained on a separate flexible disk, The flexible disk is loaded into the storage control reader. The tests are executed and controlled from the A2/A2F or C2/C2F CE test panel.

SUBSYSTEM ADDRESSING

The subsystem logical address consists of three hex digits which define the channel, controller, and device. The decoding of the controller and device portion of the address is described in the following paragraph.

If the storage control is interfaced to one or more 33801 devices operating in 3330-1, or 3330-11 mode, or to a 33502 the address decoding for all attached devices is as shown below:

STORAGE CONTROL		VOLUME *	STRING		DEVICE		
0	1	2	3	4	5	6	7
2NO HEX DIGIT				3RD HEX OIGIT			

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*This bit must be zero when addressing single volume devices.

If the storage control is interfaced only to real 3330-1 or 3330-11 devices or to 33801 devices operating only in 3350 mode, then address decoding for all attached devices is as shown below:

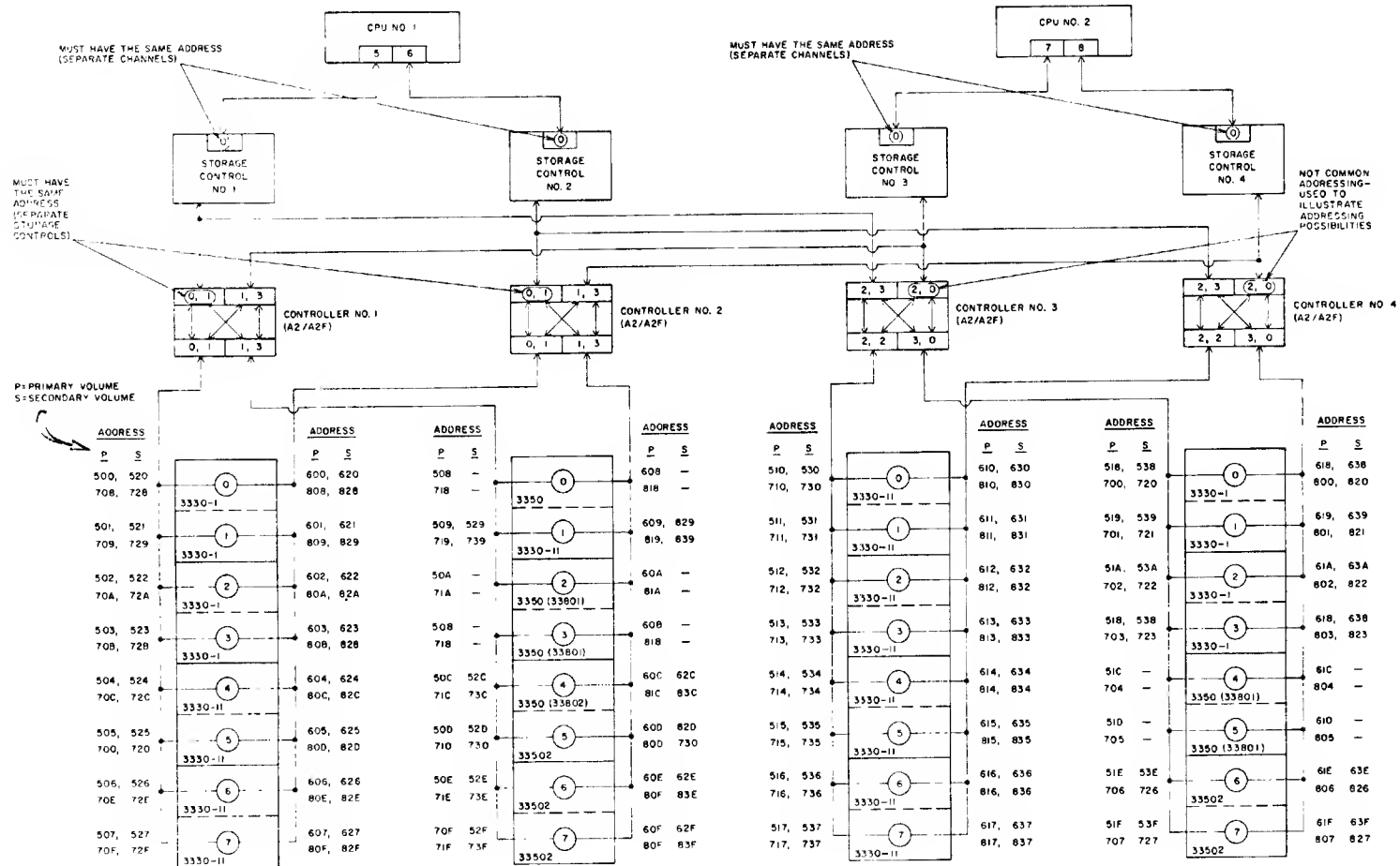| STORAGE CONTROL			STRING		DEVICE		
0	1	2	3	4	5	6	7
2NO HEX DIGIT				3RD HEX OIGIT			

9CI79

Addresses for the storage control, sting, and devices are established by the user during subsystem installation.

When emulating 3330-1, or 3330-11 devices on 33801 units, or 3350 devices on a 33502, a total of 64 logical addresses may be required (binary total of volume, string, and device address).

When attached to real 3330-1 or 3330-11 devices or to a 33801 device that is operating in 3350 compatibility mode, a total of 32 logical addresses may be required (binary total of string and device address).
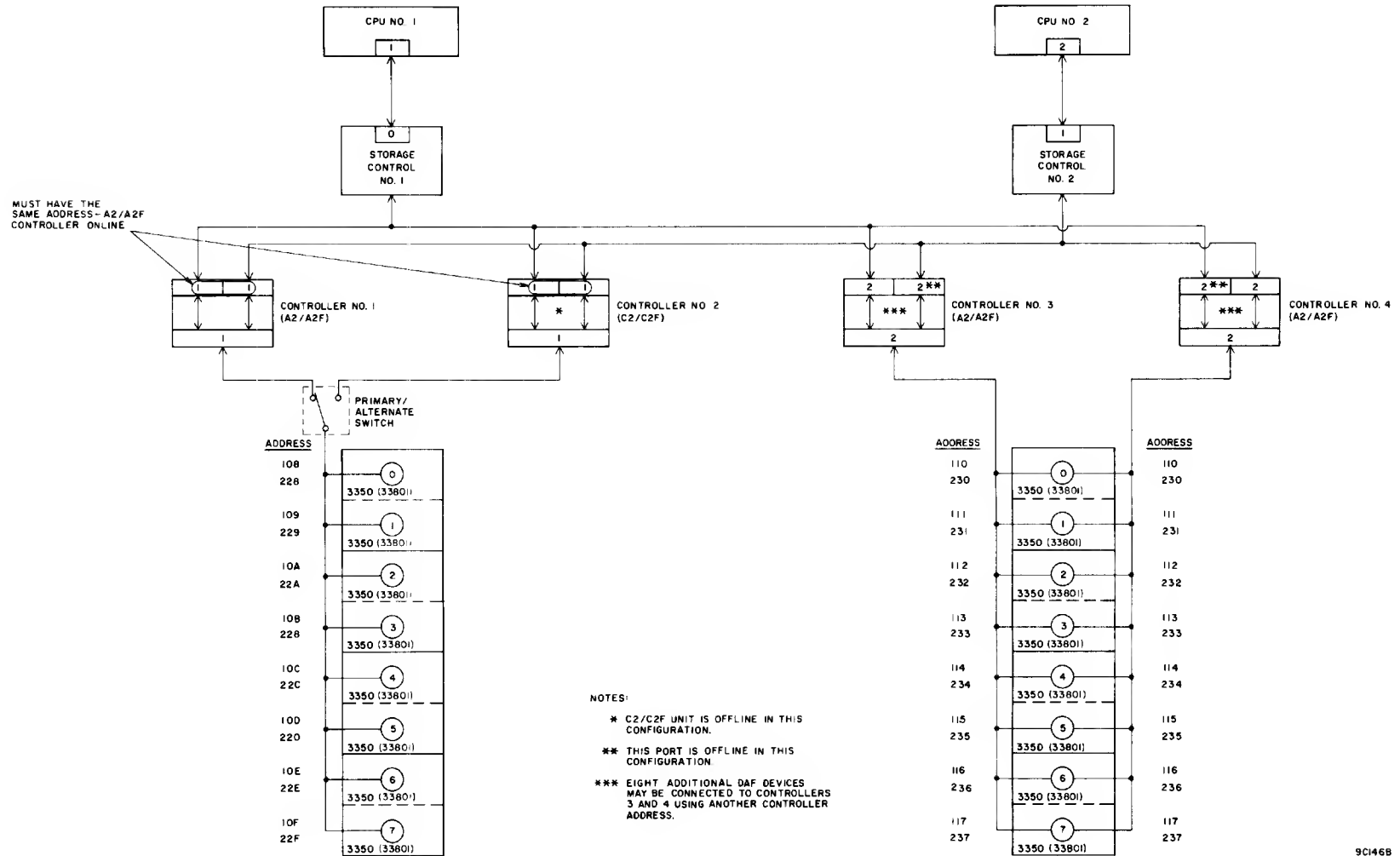
Smaller configurations of 8 and 16 logical addresses can also be configured. The smaller address configurations require fewer unit control words (UCWs) in the channel. The range of drive addresses for each configuration is shown in table 7.

Sample subsystem configurations are shown in figure 1, sheets 1 and 2.

Figure 1. Sample Configuration (Sheet 1)

NOTES:

* C2/C2F UNIT IS OFFLINE IN THIS CONFIGURATION.

** THIS PORT IS OFFLINE IN THIS CONFIGURATION.

*** EIGHT ADDITIONAL DAF DEVICES MAY BE CONNECTED TO CONTROLLERS 3 AND 4 USING ANOTHER CONTROLLER ADDRESS.

9C146B

Figure 1. Sample Configuration (Sheet 2)

TABLE 7. DEVICE ADDRESSING RANGES

DUAL VOLUME MODES			SINGLE VOLUME MODE		
Primary Addresses	Secondary Addresses	Addresses Required	Address Ranges from 00 to 7F	Addresses Required	Address Ranges from 80 to FF
00-07	20-27	16	00-07	8	80-87
00-07,10-17	20-27,30-37	32	00-07,10-17	16	80-87,90-97
00-0F	20-2F	32	00-0F	16	80-8F
00-1F	20-3F	64	00-1F	32	80-9F
08-0F	28-2F	16	08-0F	8	88-8F
08-0F,18-1F	28-2F,38-3F	32	08-0F,18-1F	16	88-8F,98-9F
10-17	30-37	16	10-17	8	90-97
10-1F	30-3F	32	10-1F	16	90-9F
18-1F	38-3F	16	18-1F	8	98-9F
40-47	60-67	16	20-27	8	A0-A7
40-47,50-57	60-67,70-77	32	20-27,30-37	16	A0-A7,B0-B7
40-4F	60-6F	32	20-2F	16	A0-AF
40-5F	60-7F	64	20-3F	32	A0-BF
48-4F	68-6F	16	28-2F	8	A8-AF
48-4F,58-5F	68-6F,78-7F	32	28-2F,38-3F	16	A8-AF,B8-BF
50-57	70-77	16	30-37	8	B0-B7
50-5F	70-7F	32	30-3F	16	B0-BF
58-5F	78-7F	16	38-3F	8	B8-BF
80-87	A0-A7	16	40-47	8	C0-C7
80-87,90-97	A0-A7,B0-B7	32	40-47,50-57	16	C0-C7,D0-D7
80-8F	A0-AF	32	40-4F	16	C0-CF
80-9F	A0-BF	64	40-5F	32	C0-DF
88-8F	A8-AF	16	48-4F	8	C8-CF
88-8F,98-9F	A8-AF,B8-BF	32	48-4F,58-5F	16	C8-CF,D8-DF
90-97	B0-B7	16	50-57	8	D0-D7
90-9F	B0-BF	32	50-5F	16	D0-DF
98-9F	B8-BF	16	58-5F	8	D8-DF
C0-C7	E0-E7	16	60-67	8	E0-E7
C0-C7,D0-D7	E0-E7,F0-F7	32	60-67,70-77	16	E0-E7,F0-F7
C0-CF	E0-EF	32	60-6F	16	E0-EF
C0-DF	E0-EF	64	60-7F	32	E0-FF
C8-CF	E8-EF	16	68-6F	8	E8-EF
C8-CF,D8-DF	E8-EF,F8-FF	32	68-6F,78-7F	16	E8-EF,F8-FF
D0-D7	F0-F7	16	70-77	8	F0-F7
D0-DF	F0-FF	32	70-7F	16	F0-FF
D8-DF	F8-FF	16	78-7F	8	F8-FF

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ADDRESSING CONSIDERATIONS

The following restrictions apply when the dual access feature, alternate controller, and string switch features are incorporated in the subsystem:

1. Effective use of Optional Channel (OS), Channel Rotation (VS), and Alternate Path Retry requires that each path to a DAF device from a single CPU have a unique channel address, but identical storage control, controller, and device addresses as shown in figure 1, sheet 1.

2. The simultaneous use of the string switch feature and the dual access feature requires a minimum of three storage control units attached to separate channels on a single CPU, or to separate channels on multi-CPU systems.

3. Two or more storage control units cannot have the same address on a single CPU channel.

4. Two or more controllers cannot have the same address on the same storage control channel.

5. In strings which incorporate both an A2/A2F unit and a C2/C2F unit, the integrated controllers in each unit must be set to the same address(es). See figure 1, sheet 2.

ERROR CHECKING

Data is checked at the channel, controller, and device level to ensure integrity. Two methods are used:

● Byte Parity	All byte transfers on the channel and controller interface utilize odd parity. This means that a parity bit is added (or not added) such that the total number of "1" bits is odd. Each byte is checked for odd parity by the receiving device.
● Error Correction Code (ECC)	As data is written on the module, special error check bytes are appended onto each field by the ECC logic in the controller. During subsequent read or search operations, the error check bytes are recalculated and compared against the check bytes appended

to each field. Single error bursts of ten bits or less are detectable. ECC information on correctable errors (error bursts of four bits or less) occuring in a data field is transmitted to the system for correction. Uncorrectable errors are handled by the system error recovery procedures.

DIAGNOSTICS

Diagnostic AIDEs supplied with each subsystem are described below:

● SOLEX diagnostics permit online testing without the need for IBM OLTEP. The SOLEX diagnostics must be installed into appropriate operating system libraries to function in an online environment. The installation procedure varies depending upon the type of operating system and the level of online diagnostic support desired. Two levels of online support are provided: standard and extended.

Standard level support does not permit privileged I/O operations (e.g. Recalibrate, Write Home Address, Write Record Zero commands). All testing occurs in an area of the HDA allocated to SOLEX by the operating system file management system. Any attempt to perform SOLEX testing outside of this area will be inhibited. The allocated area should be at least one cylinder in size regardless of mode.

Extended level support permits all I/O operations including full HDA scan seeks to alternate and CE cylinders. The entire HDA is available for testing, but no write operations may be performed outside the CE cylinders.

Standalone SOLEX diagnostics are similar to extended level diagnostic support with the addition of certain tests that can be performed only in a dedicated system. These tests generally involve timing exercises.

The online SOLEX diagnostics require the equivalent of three 3330 cylinders for library space, and a minimum of one cylinder on the device being tested. The test area is located in the customer area of the HDA for standard support operations and in the CE cylinder for extended support operations.

Standalone SOLEX diagnostics do not require library space and all testing is performed in the CE cylinder.

- Subsystem microdiagnostic tests are executed in the storage control. These tests permit the CE to check the operation of the controller and attached devices. The tests can be executed in inline or offline mode. When executed in inline mode, the testing proceeds on a selected device without interrupting normal operation on the remaining devices. The subsystem microdiagnostic tests are controlled from the A2/A2F or C2/C2F maintenance panel (figure 2). These tests are similar in content and comprehensiveness to IBM 3350 subsystem diagnostics.

  Prior to executing the subsystem microdiagnostic tests, the device to be tested must be placed in CE mode (see figure 3).

  When the subsystem includes the CDC 38302 Storage Control, an additional set of microdiagnostics is provided to check the operation of the storage control. The storage control microdiagnostic tests operate only in offline mode and are controlled from the 38302 maintenance panel (figure 4). The functional microprogram provided with the 38302 Storage Control contains a hardcore microdiagnostic that is executed whenever the storage control is powered up. The hardcore tests exercise the microprocessor prior to loading functional data into memory.
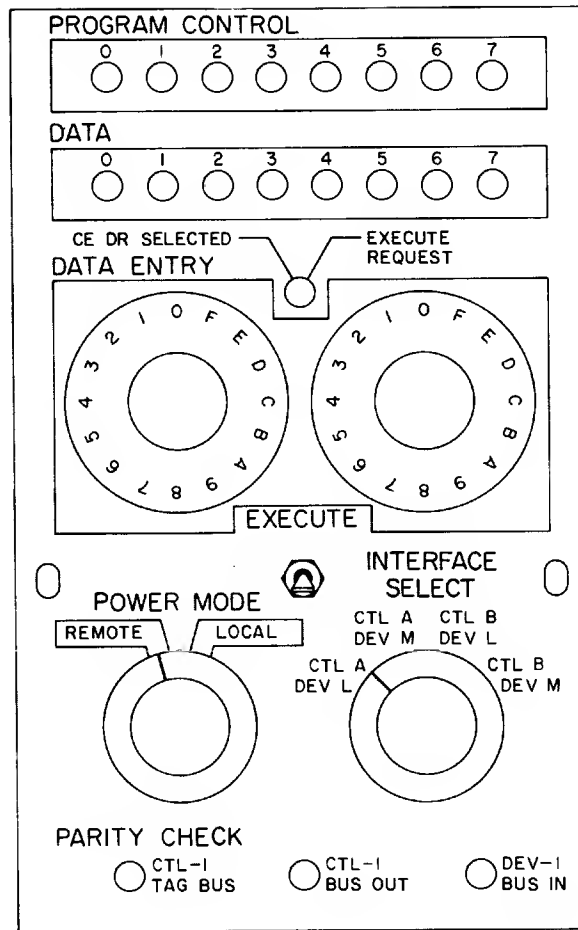
HARDWARE ANALYSIS PROGRAM

The Hardware Analysis Program (HAP), product 33801-902, is used to determine if there are device or storage media problems on 33801 or 33502 devices. The program can be run under the following operating systems:
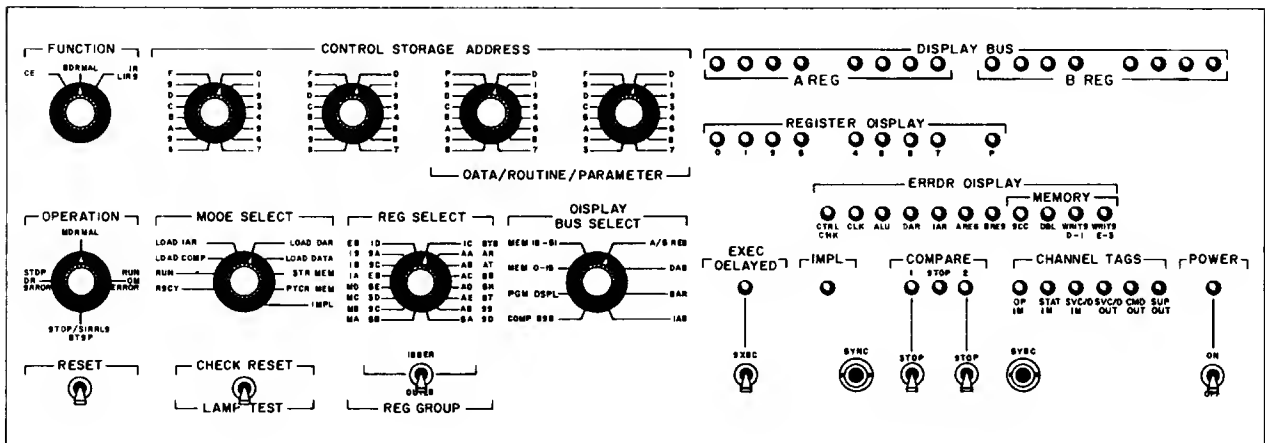
Operating System	Minimum Release Level
DOS/VS	34.0
OS/VS1	6.0
OS/VS2 (SVS)	1.7
OS/VS2 (MVS)	3.7

Figure 2. CE Test Panel
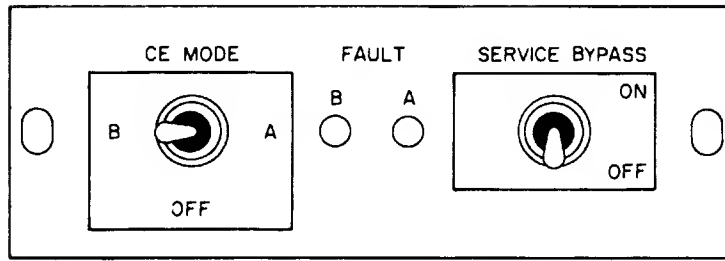
Figure 3. CE Service Panel

Figure 4. 38302 Maintenance Panel

INSTALLATION AND OPERATION

INSTALLATION REQUIREMENTS

All channel and controller interface cabling including the bus/tag cabling between the A2/A2F and C2/C2F unit, must be routed underneath the false floor. Device I/O and power cables are routed inside the units (all units are bolted together).

Figures 5 and 6 illustrate the floor space requirements for the CDC storage control and the disk storage units. Figure 7 shows the service clearance requirements for a sample subsystem incorporating a 38302 Storage Control.

CONTROLS AND INDICATORS

The operator controls and indicators are located on the front of the storage control and disk storage cabinets. These controls and indicators are described in table 8 and illustrated in figures 8 through 11. The switch descriptions assume storage control and device operation in normal mode and power sequencing under system control.
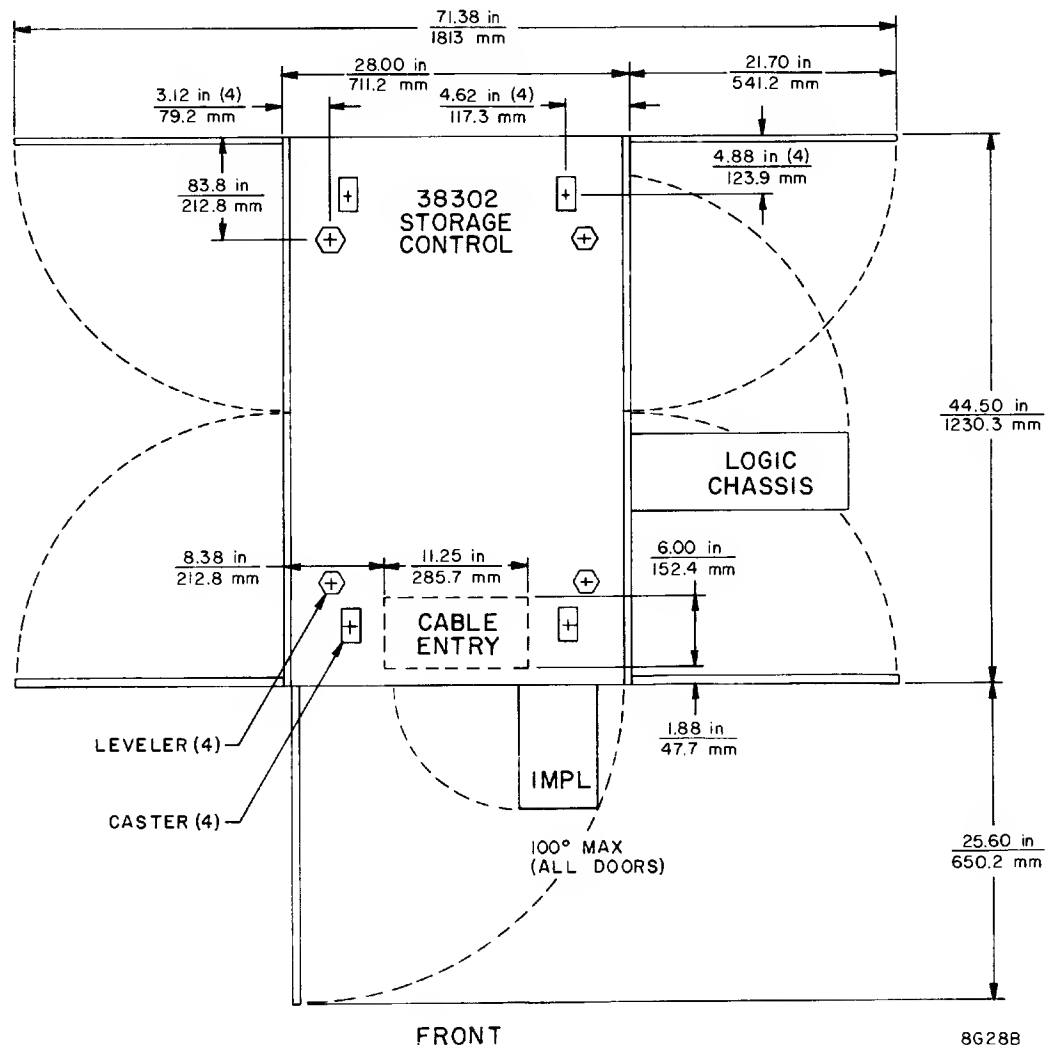
Figure 5. 38302 Space Requirements
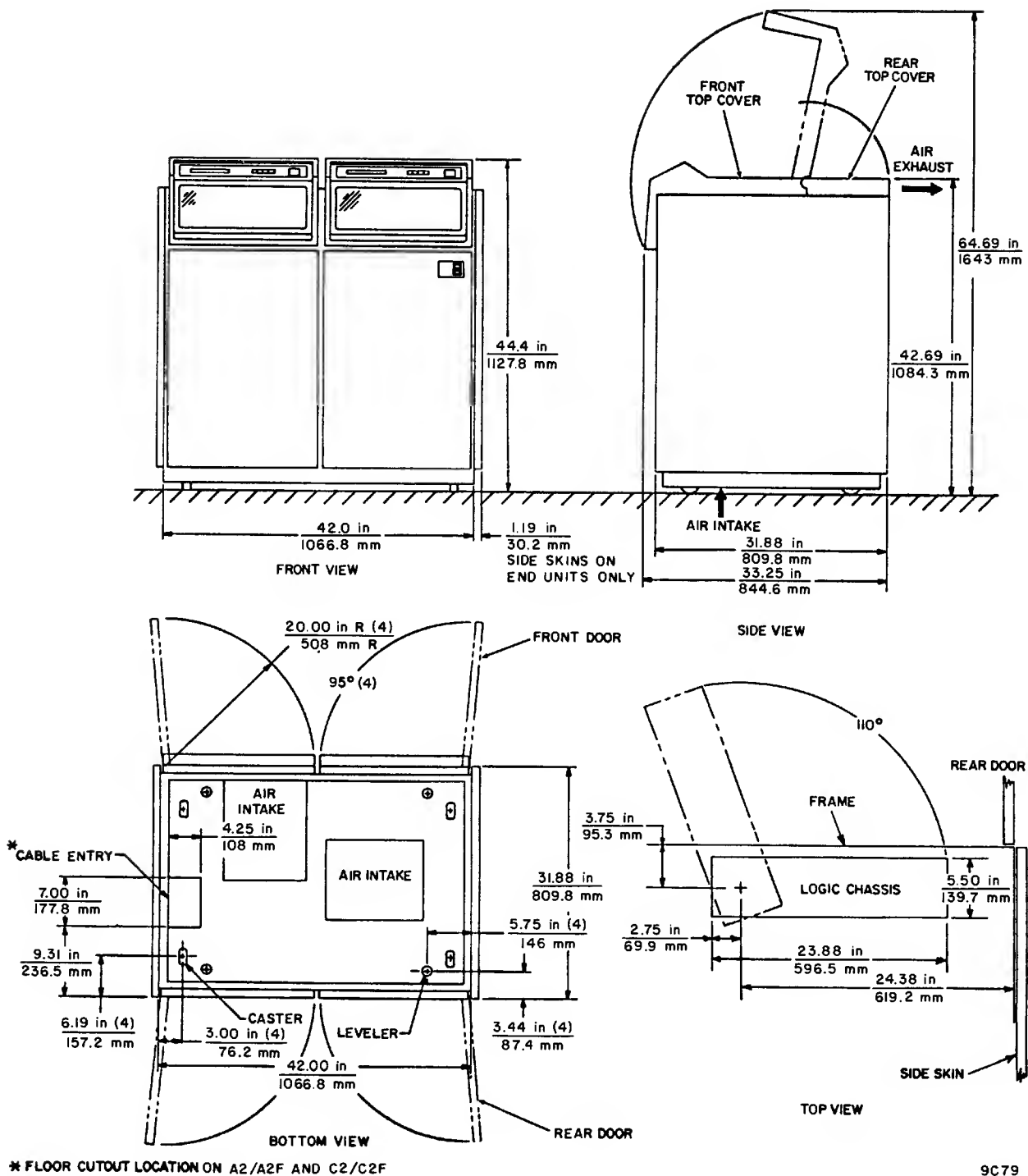
Figure 6. 33801 or 33502 Space Requirements
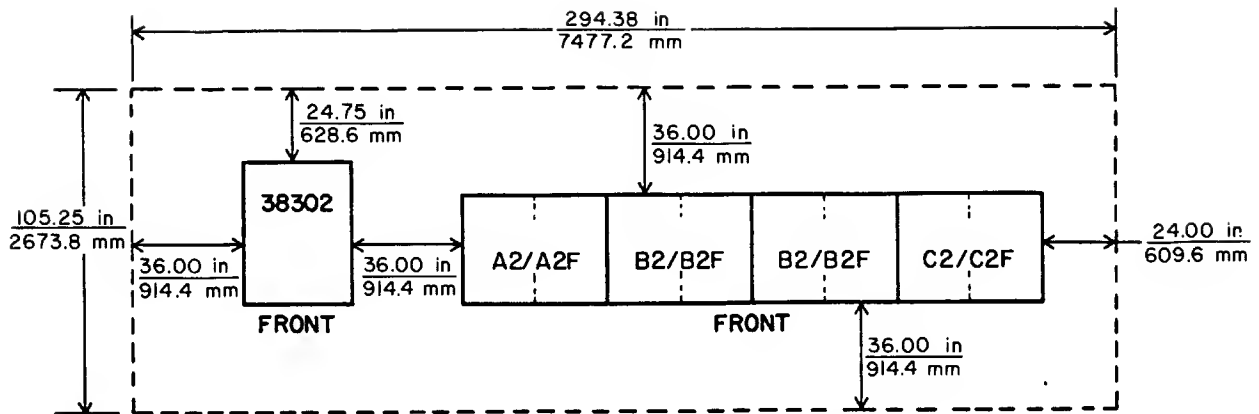
CDC 33801 OR 33502 SUBSYSTEM   8 SPINDLES
215.13 ft² (19.98 m²)

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Figure 7. Sample Subsystem Service Clearances

TABLE 8.   CONTROLS AND INDICATORS

Control/Indicator	Function
38302 Storage Control	
POWER ON switch/indicator	Turns on storage control ac/dc power and provides sequence power to the attached device strings. Normal power-on sequencing from the system overrides this switch and automatically turns on storage control power and device sequence power. Indicates that storage ac/dc power is on.
POWER OFF switch	Turns off storage control ac/dc power and removes sequence power from the attached device strings. Normal power-off sequencing from the system overrides this switch and automatically turns off storage control power and removes device sequence power.
CHANNEL A-D ENABLE switch/indicator	Each switch independently controls I/O communication between the storage control and the corresponding channel. Selected channel is enabled when indicator is illuminated.
Table continued on next page	

TABLE 8. CONTROLS AND INDICATORS (Contd)

Control/Indicator	Function
MULTI-TAG switch/indicator	Controls tagging of unsolicited interrupts (device going ready) in multi-channel storage controls. When switch is on (indicator illuminated) Device End status is presented to all enabled channels. When the switch is off, the first enabled channel responding to the interrupt clears the device and status.
User Meter	Records storage control operating time whenever the system Metering Out signal is active.
A2/A2F Power Control Panel	
POWER ON switch/indicator	Turns on A2/A2F ac/dc power and provides sequence power to all drive units in the string. Normal power on sequencing from the system overrides this switch and automatically turns on A2/A2F power and drive unit sequence power. Indicates that A2/A2F power is on.
POWER ENABLE switch/indicator	When the POWER ENABLE switch is on (illuminated), ac power sequencing can be activated by pressing POWER ON or by remote control from the system. When the switch is off, ac power is removed from the A2/A2F unit and device string and cannot be activated either from the POWER ON switch or from the system. Normal power-off sequencing from the system overrides this switch, automatically turns off A2/A2F unit power, and removes device string sequence power.
CHANNEL A/B ENABLE switch/indicator (string switch units only)	Each switch independently controls I/O communication between the controller and the corresponding storage control. Selected channel is enabled when indicator is illuminated.
C2/C2F I/O Control Panel	
PRIMARY/ALTERNATE switch/indicators	Permits the user to manually select the A2/A2F (Primary) or C2/C2F (Alternate) unit as the online controller. The switch selection must be preceded by a power-off from the A2/A2F unit.
CHANNEL A/B ENABLE switch/indicator (string switch units only)	Each switch independently controls I/O communication between the controller and the corresponding storage control. Selected channel is enabled when indicator is illuminated.
Operator Panel	
ATTEN switch	Causes the device logic to perform a return to zero seek (RTZ), and, if the CE switch on device CE service panel (figure 3) is off, resets CE mode logic. Attention interrupt status is set at completion of seek operation. Note: attention interrupt becomes Device End at the channel (both volumes.
START switch/indicator	Controls power application to device spindle motor. Indicator is illuminated when switch is pressed provided power is applied to unit. Pressing switch initiates spindle motor rotation and causes heads to position to physical track zero after motor is up to speed. Pressing switch again causes spindle motor to stop after heads have been moved to Carriage Home position.
READ ONLY switch/indicator	Pressing the switch (to illuminate indicator) disables all write operations.

TABLE 8. CONTROLS AND INDICATORS (Contd)

| Control/Indicator	Function
SELECT I/II indicator	Each indicator independently illuminates when the corresponding device port is selected. Indicator remains illuminated for a minimum of 500 ms regardless of select duration or until device is deselected.
READY indicator	Illuminates when the device is ready for operation (heads loaded).
PORT I/II ENABLE switch	Each switch independently controls I/O communication between the controller and the corresponding port on the device. Selected port is enabled when indicator is illuminated.
OFFLINE indicator	Illuminates when CE Mode latch is set. CE Mode latch is set by placing CE Mode switch to position A or B. Indicator is extinguished by pressing ATTN (Attention) switch or by executing a power on reset.

8K47
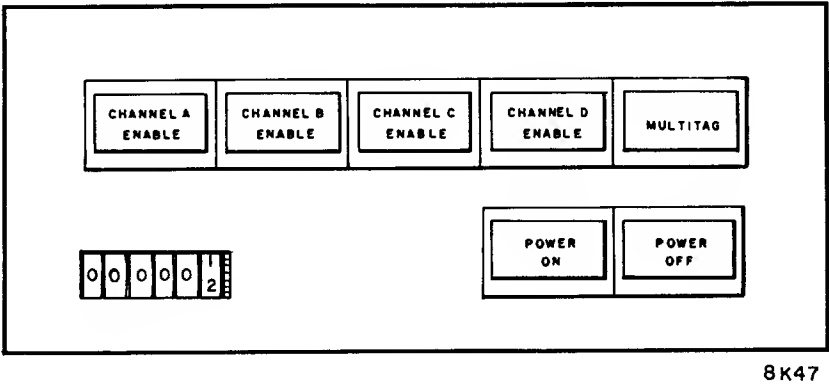
Figure 8. 38302 Operator Panel
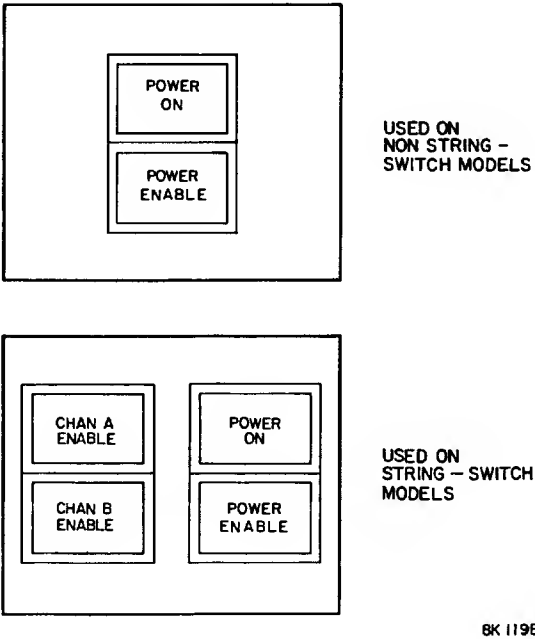

8K1198

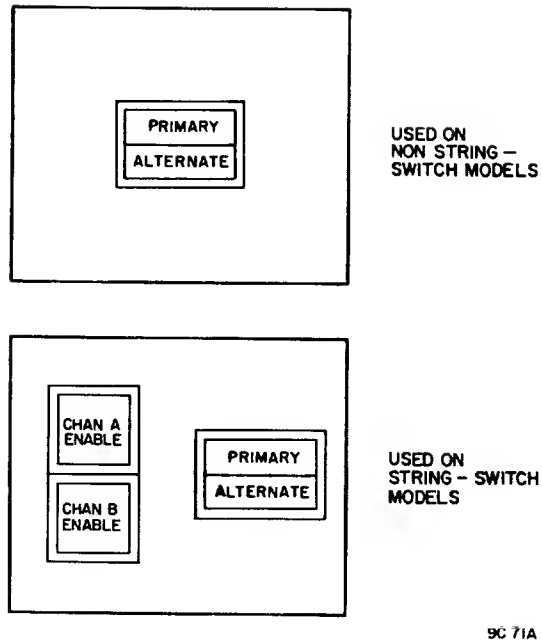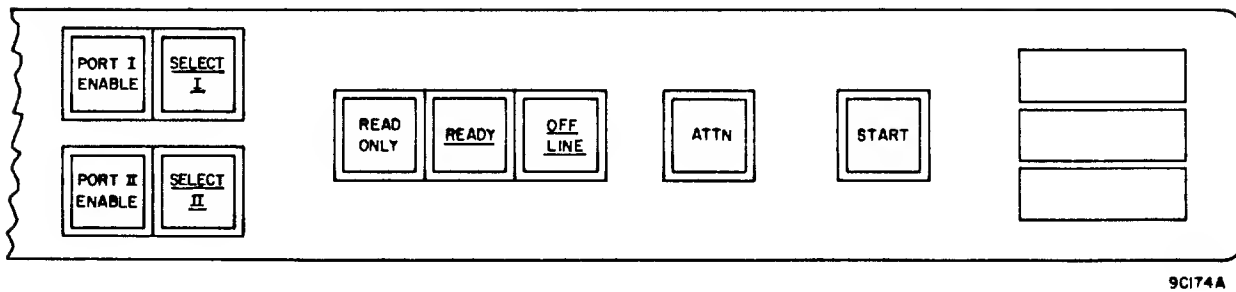Figure 9. A2/A2F Power Control Panel

Figure 10. C2/C2F I/O Control Panel

Figure 11. Device Operator Panel

TEMPLATES

Site planning templates are available in four scales as shown below:

CDC Form Number	Scale
AA6300-1	½ inch = 1 ft
AA6300-2	¼ inch = 1 ft
AA6300-3	1:25 cm
AA6300-4	1:50 cm

Forms may be ordered through:

Control Data Corporation
8001 E. Bloomington Freeway
Bloomington, MN 55420
U.S.A.

Attn: Literature Distribution Services

COMMENT SHEET

MANUAL TITLE _____

_____

PUBLICATION NO. _____ REVISION _____

FROM: NAME: _____

BUSINESS
ADDRESS: _____

_____

NO POSTAGE STAMP NECESSARY IF MAILED IN U. S. A.
FOLD ON DOTTED LINES AND STAPLE

FOLD   FOLD

FOLD   FOLD

CUT ALONG LINE